fat of some kind was, however, absolutely necessary to supply the system with heat, and combining the former in this way with pea-flour was a most happy idea. The pea-sausage might either be eaten cold in the condition in which it was issued to the soldier, or made into a sort of soup with boiling water.

And here we may mention a circumstance of especial interest to scientific men, in connection with the manufacture of this new food. The *Erbswurst* was produced in such huge quantities, that it was found to be absolutely impossible to procure a sufficient number of skins and bladders to contain the preparation. All sorts of substitutes were tried. Oiled fabric and vegetable parchment, as well as other waterproof materials were essayed in vain, for an envelope was required which was elastic and unaffected by boiling water. At last a chemist stepped in and solved the problem. He proposed the use of gelatine mixed with bichromate of potash, or in other words the process employed by photographers now-a-days in producing what are termed carbon-prints. It is well known that if a solution of gelatine and bichromate of potash is spread upon paper and exposed to light, the gelatine becomes insoluble in a very short time, and will effectually resist the action of cold or hot water to dissolve it, this principle being in fact that upon which photographic prints are produced, the portions of a surface which refuse to wash away, constituting a picture. This same mixture was used for treating the sausages. The food was pressed into proper shapes and then dipped into the bichromated gelatine solution, after which it was exposed to daylight for a couple of hours, when the gelatine formed a tough skin around it, capable of being boiled with impunity.

Turning to the British soldier we find in him the most daintily fed of all warriors, unless it was the Servian in last year's war. If we are to believe special correspondents, the rations of the Servian soldiers were almost unlimited, and furnished a striking contrast to the fare of the frugal Turks. An oka, or 2½ lbs. of brown bread, half an oka of fresh meat, together with a modicum of rice, meal, and paprika was the daily ration, the last-named comestible being employed for making soup; the *pot-au-feu*, so we were assured, was to be found simmering in camp from early morn till noon, and then only came off to make room for the coffee kettle. The Servian soldiery, too, usually had a ration of spirits called slivovitch, or plum brandy, allowed them, and yet withal they had no such powers of endurance as the maize-fed Turks. In this country a soldier's ration is three quarters of a pound of meat and one pound of bread, which is supplemented in war time by a quarter of a pound of cheese, together with cocoa or tea, sugar, &c. In the Crimea there was a standing order that hot tea should always be kept ready when practicable, so that the men might partake of it at any time, and in the Abyssinian and Ashantee campaigns the camps were never broken up of a morning before the troops had been supplied with a cup of warm coffee for breakfast. Tea and coffee exercise the same effect upon the system as wine and spirits, but their stimulative action is less marked, and our commanding officers are enjoined never to issue a ration of spirit except under extraordinary circumstances, as in the case of distressing marches, or when troops are engaged in the trenches or up at the front. And yet, as we have said, with this apparently liberal feeding, our men do not receive so much actual nourishment or nitrogenous matter as the German soldier, whose mainstay is the 2lb. loaf of black bread he receives daily. The meat, bread, sugar, &c., received by our soldiers in the Crimea yielded, we are told by the Royal Commissioners, but 23·52 oz. of nutritive principle, while Germany gives her soldiers 32·96 oz., which is still further increased when the latter are fed on such highly nitrogenous diet as the pea-sausage. The Turks, poor as their food may seem to us, probably derive as much nutriment from it as English troops from their bread, meat, and cocoa, for weight for weight, the Turkish rations contain more nitrogenous matter. If, too, their meal is what is termed "whole flour" it will, since it includes the husk, contain more nitrogen still, and, like oatmeal, be one of the most generous foods known. Our Scotch troops, we fancy, would be little the worse if fed solely on porridge for a time. The reader may remember Lord Elibank's retort on Dr. Johnson's definition of oats as the food of horses in England and of men in Scotland: "Yes," said he, "and where else will you find such horses and such men?" A growing soldier, hard at work all day at gun-drill, or other laborious work, does not buy extra meat when he is hungry, but foregoes his beer at the canteen for another pound loaf, thus approaching his diet very nearly to that of the German warrior, whom we have shown lives almost entirely on bread and enjoys the most nutritive fare. At the same time it is necessary to bear in mind that the conditions under which a man lives must guide the nature of his food. A man inhabiting a cold climate such as ours, requires more animal food than would be the case if he lived in a country nearer the equator, and British troops, we fear, would loose much of their energy if fed altogether on farinaceous food. But as we have striven to show, it is not always a so-called liberal diet which affords the soldier the greatest quantity of nutriment. H. BADEN PRITCHARD

GEIKIE'S "PHYSICAL GEOGRAPHY"

Elementary Lessons in Physical Geography. By Archibald Geikie, LL.D., F.R.S., Murchison Professor of Geology and Mineralogy in the University of Edinburgh, and Director of the Geological Survey of Scotland. (London: Macmillan and Co., 1877.)

As our knowledge of natural phenomena widens and our insight into the character and mode of operation of the forces which give rise to these phenomena becomes more profound, we are called upon from time to time to take a new survey of the fields of inquiry and to reconsider the principles on which the useful, but necessarily more or less arbitrary, classification of the natural history sciences is made to depend. To instance a notable example, the time-honoured division of the "three kingdoms in nature" has now, by almost universal consent, been abandoned in favour of a more logical grouping of the objects of natural history science depending on the presence or absence in them of the principle of life, and hence has arisen the term biology to include botany and zoology, while mineralogy, released from an unnatural bond, seeks and finds new alliances with those branches of knowledge, crystallography, chemistry, and petrography, with which it has so many

and such intimate relations. Etymological purists have indeed cavilled at the term "biology," and the opponents of change have disputed its *raison d'être*, but it is impossible to deny that its invention was the natural consequence of the growth of juster views concerning the relations of living beings to one another, or that, on account of its fitness, it bids fair to survive all hostile criticism.

Now in the same way that the development of our knowledge of the lowest forms of life has led to the breaking down of the unnatural barriers between the animal and vegetable kingdoms, and the union of all the anatomical, physiological, systematic, and ætiological branches of our knowledge of living beings into the federal republic of biology, so the growth and establishment of a juster geological philosophy has greatly modified, and indeed almost revolutionised, our conception and treatment of certain branches of geographical science.

For more than half a century the principle which demands that the geologist shall interpret the past history of the globe by means of a constant reference to the operations now going on upon its surface, has been steadily gaining ground; and this postulate may now be said to have taken its place as the very cornerstone in all geological reasoning. But if geology has thus to own her dependence on geographical knowledge, she has more than requited her obligations by the new vitality which she has infused into her sister science. It is not too much to assert that the growing conviction of the necessity for a more systematic, a more searching, and a more accurate investigation of the phenomena of the globe and of the forces by which they are produced—a conviction which has prompted the despatch of expeditions for carrying out carefully organised researches both on sea and land—has been to a very great extent created and fostered by the revelations of glaring imperfections in our knowledge of the earth's existing economy which are continually being made by geology.

The work before us is an example of the treatment of geographical questions from the point of view of a geologist, and we are not surprised to find that its author is evidently strongly actuated by the conviction of the necessity for a broader and more vivid presentation of the action and reaction upon one another of the various forces operating upon the surface of the globe, than is usually found in works on physical geography, in order to convey a just idea of the character and significance of the features which it presents. Thus, in the introductory chapter, after referring to that complex interplay of agencies by which the fluid envelopes of the globe are maintained in constant circulation, and the elements of its solid crust made to pass through ever-varying cycles of change—a series of phenomena which has suggested to the profounder thinkers of all ages an analogy between our planet and a living being—the author goes on to say:—

"Now this life of the earth is the central thought which runs through all that branch of science termed physical geography. The word geography, as ordinarily used, means a description of the surface of the earth, including its natural subdivisions, such as continents and oceans, together with its artificial or political sub-divisions, such as countries and kingdoms. But physical geography is not a mere description of the parts of the earth. It takes little heed of the political boundaries except in so far as they mark the limits of different races of men. Nor does it confine itself to a mere enumeration of the different features of the surface. It tries to gather together what is known regarding the earth as a heavenly body, its constitution, and probable history. In describing the parts of the earth—air, land, and sea—it ever seeks to place them before our minds as to make us realise not only what they are in themselves, but how they affect each other, and what part each plays in the general system of our globe. Thus physical geography endeavours to present a vivid picture of the mechanism of that wonderfully complex and harmonious world in which we live."

In that easy and graceful style, of which he possesses so perfect a mastery, the author proceeds in subsequent chapters to give a sketch of those vast fields of knowledge which are opened up to us by this method of looking at the phenomena of the globe. The book is exactly what it professes to be—a series of elementary lessons; but, while it may be read with profit and delight by any fairly-taught schoolboy, it will not be found wanting in instruction and suggestiveness for more advanced students. On some questions, as for example that of the nature and causes of the great movements of the atmosphere, the author has been particularly successful in embodying within a very small compass a mass of information which the student could otherwise gain only by the perusal of a number of special treatises. To teachers of elementary science who desire a model on which to frame their lessons for beginners, so as to secure their attention and interest and to arouse the enthusiasm of such among them as are capable of that sentiment, we very heartily commend this admirable little book.

The author points out in a note that the subject of physical geography, as here treated of, is conterminous with that division of science for which the name of physiography has been suggested. The advances made in recent years in the study of physical astronomy and the relations which have been established between celestial and terrestrial objects by the development of spectrum analysis and the study of meteorites, taken in connection with that strongly-felt necessity for a deeper insight into the mode of operation of the forces operating upon the surface of the globe, both from within and without, which geological research has awakened, have independently suggested to many thinkers the desirability of permitting certain portions of natural knowledge to crystallise around a new centre. The importance of this new science thus growing up on the confines of geography, geology, astronomy, and biology, and linking them all together, a science the study of which would form the most fitting preparation for the detailed pursuit of all and each of the natural sciences, was long ago pointed out by Prof. Huxley; and in a course of lectures delivered in 1870 he sought to illustrate the objects and methods of this latest-born member of the family of the natural sciences. In that most excellent of geological text-books, Prof. Dana's "Manual of Geology," the term "physiography" is also employed, in the same sense as advocated by Prof. Huxley. Nor is the use of the term confined to English writers, for in several of the best German manuals

of geology, such as Dr. Hermann Credner's "Elemente der Geologie" and Dr. F. von Hochstetter's "Die Erde nach ihrer Zusammensetzung, ihrem Bau, und ihrer Bildung," the necessity of this term physiography is admitted and its use justified. Like the term "biology," that of "physiography" may not improbably meet with some opposition on its first introduction, but as the importance and connection of the branches of knowledge which it embraces become more widely appreciated, the necessity and convenience of the name will doubtless make themselves very generally felt. In conclusion, we cannot part from the little book which has prompted these remarks without taking the opportunity of congratulating the author on his success in presenting to the public, in a form at once compendious and popular, the outlines of this very important branch of science. J. W. J.

THE LABORATORY GUIDE

A Manual of Practical Chemistry for Colleges and Schools. Specially Arranged for Agricultural Students. By Arthur Herbert Church, M.A., Professor of Chemistry in the Agricultural College, Cirencester. Fourth Edition, revised. (London: John Van Voorst, 1877.)

THE fact that Prof. Church's "Laboratory Guide" has reached a fourth edition is a proof that the work has been found useful by that class of students for whom it is specially arranged. Notwithstanding this fact we cannot regard the book as occupying other than a second-rate position in the literature of applied chemistry. The aim of the "Guide" is (1) to place before the student a series of lessons in chemical manipulation in working through which he shall obtain a practical knowledge of "some of the chief truths learnt during the course of lectures on inorganic or mineral chemistry;" (2) to instruct the student in qualitative analysis with especial reference to the analysis of agricultural products; (3) to lay before the more advanced student a number of processes for the quantitative analysis of agricultural substances, food stuffs, manures, &c. The first part of the work comprises a number of fairly well chosen examples in chemical manipulation, preparation of gases, and examination of solid substances. What we should most object to in this portion of the "Guide" is want of method. A few blowpipe experiments are introduced here and there, followed, perhaps, by a short description of one or two rough experiments illustrative of the manufacture of superphosphates; these are succeeded by desultory tests for sugar in milk, by casual semi-quantitative experiments on bread, and so on. To a student without any knowledge of chemistry such a course as that sketched in the first part of the "Guide" may be of use, although we think more care would require to be shown in the selection of experiments; but the book assumes that the student accompanies his practical work by attendance on lectures; surely then the practical course ought, from its very commencement, to be systematic and progressive. The directions given in each lesson are, as a rule, too meagre; without the constant superintendence of a teacher we doubt whether the beginner in practical work could make much progress. In some cases the directions are so vague and inexact as to be positively misleading: witness the method for detecting alum in bread (p. 43). Part II. treating of qualitative analysis has the same failings as Part I.; it is not exact and definite. The author, in his introduction, especially announces that the work is limited in its aim, so that we cannot find fault with him for not including tests for all the metals; but so far as it goes the information given, and the system of teaching pursued, should have been definite, condensed, and such as would train the student in habits of accuracy. No doubt the reactions detailed are true so far as they go; the schemes of analysis are tolerably good, yet there is about it all a slipshod appearance which stamps the work with an unsatisfactory character.

The processes of quantitative analysis are chiefly such as are required in the examination of agricultural products, and substances used in manufacturing manures, of a few leading food stuffs, of soils, and of waters. As the author has not wished to produce a large work, he has limited himself to a description of methods of analysis "intended only for the particular case mentioned;" these processes "may fail if . . . . other substances be present than those here supposed." We cannot help thinking that this is exactly what he ought not to have done; if the book is to be a guide to the student, if it does not pretend to the place of an encyclopædic reference book, then processes of *general* applicability, should have been selected, processes which would illustrate the application of the general principles of analysis, not processes which the student is to learn by rote, and which he will therefore come to regard in much the same light as that in which the cook views her book of receipts. Many of the processes, regarded simply as prescriptions, are faulty or very meagre. Who would apply the volumetric Uranium method for determining phosphates in the manner described on pp. 157, 158? Aided only by the description of the volumetric method for determining chlorine given on pp. 159, 160, who could ever hope to perform an exact estimation of that element? From what is said on p. 150 one would suppose that "reduced phosphates" can be readily determined with something like accuracy. Th report of the British Association Committee has shown that no method for even approximately determining these phosphates has as yet been introduced.

The processes for the analysis of milk, cheese, and butter are extremely meagre. Now that we are possessed of really good and reliable methods for analysing these food stuffs, the introduction into a manual of vague and sketchy methods is almost worse than the omission of all methods, whether good or bad.

One point there is in which Prof. Church deserves all praise, namely, the employment of a systematic nomenclature. The system adopted is that first employed in the works of Roscoe, and of Harcourt and Madan, and now adopted in the *Journal* of the Chemical Society, in Watts's *Dictionary*, and in most of the modern treatises. This system, although not slavishly bound down by rule—although it allows one to say *sulphate of zinc* as well as *zincic sulphate*—is founded on certain definite ideas, and has, at the same time, shown itself capable of expansion with the needs of an increasing science.

The system is, moreover, nearly identical with that employed by the German chemists. Prof. Church has done well in making use of it.